

Allen-Bradley

1336/1336VT/1336 PLUS/PLUS II/IMPACT

1336 FORCE Drives

Dynamic Braking

Series D Cat. No. 1336-MOD-KA005, KB005 and KC005

Series D Cat. No. 1336-MOD-KA010, KB010 and KC010

Series D Cat. No. 1336-MOD-KB050 and KC050

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What This Option Provides

The Heavy Duty Dynamic Braking Option provides a self contained NEMA Type 1 enclosed assembly that is wired to a 1336 AC Drive. Dynamic braking can increase the braking torque capability of a drive up to 100%.

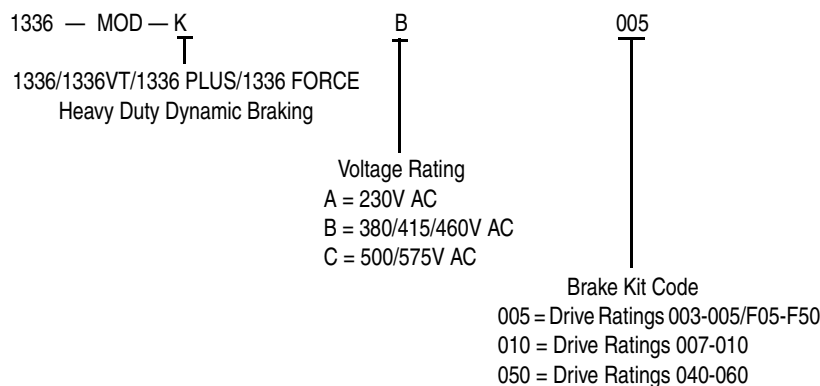
Where This Option Is Used

B003-B250 and C003-C250 1336 Drives

B003-B250 1336VT Drives

AQF05-A010, BRF05-B250 and C007-C250 1336 PLUS and 1336 FORCE Drives

Catalog Number Description



What These Instructions Contain

These instructions describe Dynamic Brake Module operation and explain how to calculate the data needed to correctly select, configure and install a Heavy Duty Dynamic Brake Module. By completing **How to Select a Dynamic Brake Module** first, you will be able to determine:

1. Whether or not Heavy Duty Dynamic Braking is required for your application.
2. If Heavy Duty Dynamic Braking is required, the rating and quantity of brakes required.

How Dynamic Braking Works

When an induction motor's rotor is turning slower than the synchronous speed set by the drive's output power, the motor is transforming electrical energy obtained from the drive into mechanical energy available at the drive shaft of the motor. This process is referred to as *motoring*. When the rotor is turning faster than the synchronous speed set by the drive's output power, the motor is transforming mechanical energy available at the drive shaft of the motor into electrical energy that can be transferred back into the utility grid. This process is referred to as *regeneration*.

Most AC PWM drives convert AC power from the fixed frequency utility grid into DC power by means of a diode rectifier bridge or controlled SCR bridge before it is inverted into variable frequency AC power. Diode and SCR bridges are cost effective, but can only handle power in the motoring direction. Therefore, if the motor is regenerating, the bridge cannot conduct the necessary negative DC current, the DC bus voltage will increase and cause a Bus Overvoltage trip at the drive.

How The Dynamic Brake Module Works

Expensive bridge configurations use SCRs or transistors that can transform DC regenerative electrical energy into fixed frequency utility electrical energy. A more cost effective solution is to provide a Transistor Chopper on the DC Bus of the AC PWM drive that feeds a power resistor which transforms the regenerative electrical energy into thermal energy. This is generally referred to as Dynamic Braking.

A Dynamic Brake Module consists of a Chopper Module (a chopper transistor and related control components) and a Dynamic Brake Resistor. **Figure 1** shows a simplified schematic of a Dynamic Brake Module. The Chopper Module is shown connected to the positive and negative DC Bus conductors of an AC PWM Drive. The two series connected Bus Caps are part of the DC Bus filter of the AC Drive.

A Chopper Module contains five significant power components:

Protective fuses are sized to work in conjunction with a **Crowbar SCR**. Sensing circuitry within the Chopper Transistor Voltage Control determines if an abnormal condition exists within the Chopper Module, such as a shorted Chopper Transistor or open Dynamic Brake Resistor. When an abnormal condition is sensed, the Chopper Transistor Voltage Control will fire the Crowbar SCR, shorting the DC Bus and melting the fuse link. This action isolates the Chopper Module from the DC Bus until the problem can be resolved.

The **Chopper Transistor** is an Insulated Gate Bipolar Transistor (IGBT). The Chopper Transistor is either ON or OFF, connecting the Dynamic Brake Resistor to the DC Bus and dissipating power, or isolating the resistor from the DC Bus. There are several transistor ratings that are used in the various Dynamic Brake Module ratings. The most important rating is the collector current rating of the Chopper Transistor that helps to determine the minimum ohmic value used for the Dynamic Brake Resistor.

Chopper Transistor Voltage Control regulates the voltage of the DC Bus during regeneration. The average values of DC Bus voltages are:

- 375V DC (for 230V AC input)
- 750 V DC (for 460V AC input)
- 937.5V DC (for 575V AC input)

Voltage dividers reduce the DC Bus voltage to a value that is usable in signal circuit isolation and control. The DC Bus feedback voltage from the voltage dividers is compared to a reference voltage to actuate the Chopper Transistor.

The **Freewheel Diode** (FWD), in parallel with the Dynamic Brake Resistor, allows any magnetic energy stored in the parasitic inductance of that circuit to be safely dissipated during turn off of the Chopper Transistor.

The diagram illustrates a dynamic brake circuit for a DC motor, connected between a + DC Bus and a - DC Bus. The circuit includes the following components and connections:

- Power Input:** The + DC Bus is connected to the circuit through a **Fuse**.
- Dynamic Brake Resistor:** A resistor connected in series with the + DC Bus. Its other terminal is connected to the emitter of a **Chopper Transistor**.
- Chopper Transistor:** The base of the transistor is connected to the **Chopper Transistor Voltage Control** block. The collector is connected to the + DC Bus.
- Diode Bridge:** Two diodes are connected in series between the emitter of the chopper transistor and the - DC Bus. The junction between the two diodes is connected to a **Signal Common** point.
- Voltage Dividers:** Two voltage dividers are connected across the diode bridge. Each divider consists of a resistor and a wiper. The wipers are connected to **To Voltage Control** signals.
- Crowbar SCR:** A Silicon Controlled Rectifier (SCR) is connected between the + DC Bus and the - DC Bus. The gate of the SCR is connected to a **To Voltage Control** signal.
- Bus Capacitors:** Two **Bus Caps** are connected across the + DC Bus and - DC Bus to filter the supply.
- Control Signals:**
 - The **Chopper Transistor Voltage Control** block receives two **To Voltage Dividers** signals and sends a **To Crowbar SCR Gate** signal.
 - The **Signal Common** point is connected to a **To Voltage Control** signal.

- **DC Power** light illuminates when DC power has been applied to the Dynamic Brake Module.
- **Brake On** light flickers when the Chopper Module is operating or chopping.

How to Select a Dynamic Brake Module

As a rule, a Dynamic Brake Module can be specified when regenerative energy is dissipated on an occasional or periodic basis. In general, the motor power rating, speed, torque, and details regarding the regenerative mode of operation will be needed in order to estimate what Dynamic Brake Module rating to use. When a drive is consistently operating in the regenerative mode of operation, serious consideration should be given to equipment that will transform the electrical energy back to the fixed frequency utility.

The peak regenerative power of the drive must be calculated in order to determine the maximum ohmic value of the Dynamic Brake Resistor of the Dynamic Brake Module. Once the maximum ohmic value of the Dynamic Brake Resistor current rating is known, the required rating and number of Dynamic Brake Modules can be determined. If a Dynamic Brake Resistance value greater than the minimum imposed by the choice of the peak regenerative power is made and applied, the drive can trip off due to transient DC Bus overvoltage problems. Once the approximate ohmic value of the Dynamic Brake Resistor is determined, the necessary power rating of the Dynamic Brake Resistor can be calculated.

The wattage rating of the Dynamic Brake Resistor is estimated by applying what is known about the drive's motoring and regenerating modes of operation. The average power dissipation of the regenerative mode must be estimated and the wattage of the Dynamic Brake Resistor chosen to be greater than the average regenerative power dissipation of the drive. If the Dynamic Brake Resistor has a large thermodynamic heat capacity, then the resistor element will be able to absorb a large amount of energy without the temperature of the resistor element exceeding the operational temperature rating. Thermal time constants in the order of 50 seconds and higher satisfy the criteria of large heat capacities for these applications. If a resistor has a small heat capacity, defined as thermal time constants less than 5 seconds, the temperature of the resistor element could exceed maximum temperature limits during the application of pulse power to the element and could exceed the safe temperature limits of the resistor. The resistors used in the Dynamic Brake Modules have thermodynamic time constants of less than 5 seconds. This means restrictions must be imposed upon the application of the Dynamic Brake Modules.

Peak regenerative power can be calculated as:

- Horsepower (English units)
- Watts (The International System of Units, SI)
- Per Unit System (pu) which is dimensionless

The final number must be in watts of power to estimate the ohmic value of the Dynamic Brake Resistor. The following calculations are demonstrated in SI units.

How to Select a Dynamic Brake Module

Gather the following information:

- Power rating from motor nameplate in watts, kilowatts, or horsepower
- Speed rating from motor nameplate in rpm or rps (radians per second)
- Motor inertia and load inertia in kg-m² or lb-ft²
- Gear ratio (GR) if a gear is present between the motor and load
- Motor shaft speed, torque, and power profile of the drive application

Figure 2 shows the speed, torque, and power profiles of the drive as a function of time for a particular cyclic application that is periodic over t_4 seconds. The desired time to decelerate is known or calculable and is within the drive performance limits. In **Figure 2**, the following variables are defined:

$\omega(t)$ = Motor shaft speed in radians per second (**rps**)

$$\omega = \frac{2\pi N}{60}$$

$N(t)$ = Motor shaft speed in Revolutions Per Minute (**RPM**)

$T(t)$ = Motor shaft torque in Newton-meters

$$1.0 \text{ lb-ft} = 1.355818 \text{ N-m}$$

$P(t)$ = Motor shaft power in watts

$$1.0 \text{ HP} = 746 \text{ watts}$$

ω_b = Rated angular rotational speed

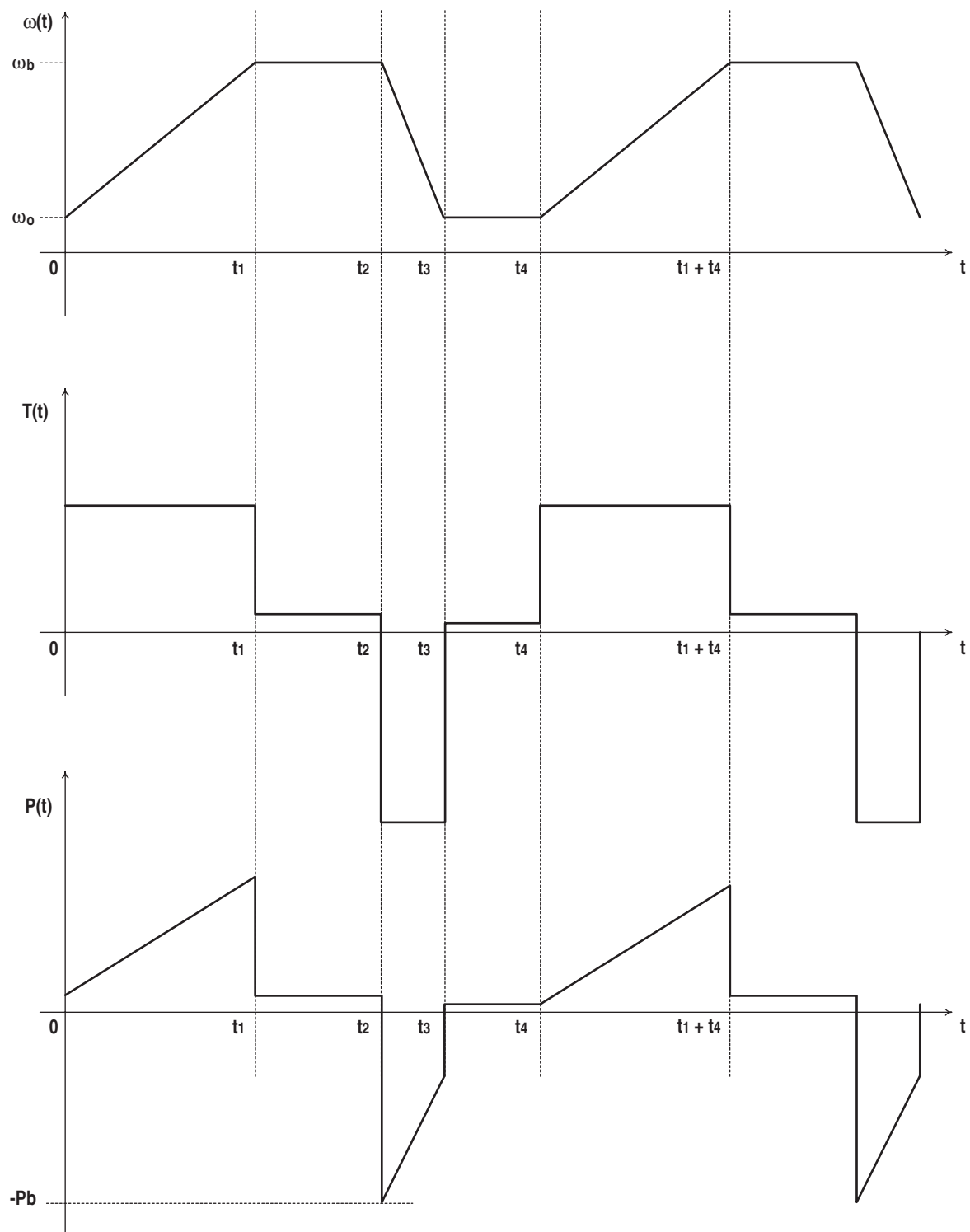
$$\text{Rad/s}$$

ω_o = Angular rotational speed less than ω_b (can equal 0)

$$\text{Rad/s}$$

$-P_b$ = Motor shaft peak regenerative power in watts

Figure 2
Application Speed, Torque and Power Profiles



Step 1 — Determine the Total Inertia

$$J_T = J_m + (GR^2 \times J_L) \qquad 1.0 \text{ lb-ft}^2 = 0.04214011 \text{ kg-m}^2$$

J_T = Total inertia reflected to the motor shaft (kg-m²)

J_m = Motor inertia (kg-m²)

GR = Gear ratio for any gear between motor and load (dimensionless)

Note: For 2:1 gear ratio, $GR = 0.5$.

J_L = Load inertia (kg-m²)

$$J_T = \quad + (\quad \times \quad) \qquad J_T = \quad \text{kg-m}^2$$

Step 2 — Calculate the Peak Braking Power

$$P_b = \frac{J_T \times \omega_b (\omega_b - \omega_o)}{t_3 - t_2}$$

J_T = Total inertia reflected to the motor shaft (kg-m²)

ω_b = Rated angular rotational speed (**Rad / s** = $2\pi N_b / 60$)

ω_o = Angular rotational speed,
less than rated speed down to zero (**Rad / s**)

N_b = Rated motor speed (RPM)

$t_3 - t_2$ = Deceleration time from ω_b to ω_o (seconds)

P_b = Peak braking power (watts)
1.0 HP = 746 watts

$$P_b = \frac{\quad \times \quad (\quad - \quad)}{[\quad - \quad]} \qquad P_b = \quad \text{watts}$$

Compare the peak braking power to that of the rated motor power. If the peak braking power is greater than 1.5 times that of the motor, then the deceleration time ($t_3 - t_2$) needs to be increased so that the drive does not go into current limit. (This is assuming that 150% of motor power is less than or equal to 150% drive capacity.)

Step 3 — Calculate the Maximum Dynamic Brake Resistance Value

$$R_{db1} = \frac{0.9 \times V_d^2}{P_b}$$

V_d = DC Bus voltage the chopper module regulates to (375V DC, 750V DC, or 937.5V DC)
 P_b = Peak braking power calculated in Step 2 (watts)
 R_{db1} = Maximum allowable value for the dynamic brake resistor (ohms)

$$R_{db1} = \left[\frac{\quad \times \quad}{\quad} \right] \quad R_{db1} = \quad \text{ohms}$$

The choice of the Dynamic Brake resistance value should be less than the value calculated in **Step 3**. If the resistance value is greater than the value calculated in **Step 3**, the drive can trip on DC Bus overvoltage. Do not reduce P_b by any ratio because of estimated losses in the motor and inverter. This has been accounted for by an offsetting increase in the manufacturing tolerance of the resistance value and the increase in resistance value due to the temperature coefficient of resistor element.

Step 4 — Choose the Correct Dynamic Brake Module

Go to Table 1a, 2a, or 3a in this publication and choose the correct Dynamic Brake Module based upon the resistance value being less than the maximum value of resistance calculated in **Step 3**. If the Dynamic Brake Resistor value of one Dynamic Brake Module is not sufficiently low, consider using up to three Dynamic Brake Modules in parallel, such that the parallel Dynamic Brake resistance is less than R_{db1} calculated in **Step 3**. If the parallel combination of Dynamic Brake Modules becomes too complicated for the application, consider using a Brake Chopper Module with a separately specified Dynamic Brake Resistor.

Step 5 — Estimate the Minimum Wattage Requirements for the Dynamic Brake Resistors

It is assumed that the application exhibits a periodic function of acceleration and deceleration. If $(t_3 - t_2)$ equals the time in seconds necessary for deceleration from rated speed to ω_o speed, and t_4 is the time in seconds before the process repeats itself, then the average duty cycle is $(t_3 - t_2)/t_4$. The power as a function of time is a linearly decreasing function from a value equal to the peak regenerative power to some lesser value after $(t_3 - t_2)$ seconds have elapsed. The average power regenerated over the interval of $(t_3 - t_2)$ seconds is:

$$\frac{P_b}{2} \left(\frac{\omega_b + \omega_o}{\omega_b} \right)$$

The average power in watts regenerated over the period t_4 is:

$$P_{av} = \frac{[t_3 - t_2]}{t_4} \times \frac{P_b}{2} \left(\frac{\omega_b + \omega_o}{\omega_b} \right)$$

P_{av} = Average dynamic brake resistor dissipation (watts)

$t_3 - t_2$ = Deceleration time from ω_b to ω_o (seconds)

t_4 = Total cycle time or period of process (seconds)

P_b = Peak braking power (watts)

ω_b = Rated motor speed (Rad / s)

ω_o = A lower motor speed (Rad / s)

$$P_{av} = \left[\frac{\quad - \quad}{\quad} \right] \times \left[\frac{\quad}{2} \right] \times \left(\frac{\quad + \quad}{\quad} \right)$$

$P_{av} = \quad$ watts

The Dynamic Brake Resistor power rating of the Dynamic Brake Module (singly or two in parallel) that will be chosen must be greater than the value calculated in **Step 5**. If it is not, then a Brake Chopper Module with the suitable Dynamic Brake Resistor must be specified for the application.

Step 6 — Calculate the Percent Average Load of the Dynamic Brake Resistor

$$AL = \frac{P_{av}}{P_{db}} \times 100$$

AL = Average load in percent of Dynamic Brake Resistor

P_{av} = Average dynamic brake resistor dissipation calculated in Step 5 (watts)

P_{db} = Steady state power dissipation capacity of dynamic brake resistors obtained from Table 1a, 2a, or 3a (watts)

$$AL = \left[\frac{\quad}{\quad} \right] \times 100$$

$AL = \quad$ %

The calculation of AL is the Dynamic Brake Resistor load expressed as a percent. P_{db} is the sum of the Dynamic Brake Module dissipation capacity and is obtained from Table 1a, 2a, or 3a. This will give a data point for a line to be drawn on the curve in **Figure 3**. The number calculated for AL must be less than 100%. If AL is greater than 100%, an error was made in a calculation or the wrong Dynamic Brake Module was selected.

Step 7 — Calculate the Percent Peak Load of the Dynamic Brake Resistor

$$PL = \frac{P_b}{P_{db}} \times 100$$

PL = Peak load in percent of Dynamic Brake Resistor

P_b = Peak braking power calculated in Step 2 (watts)

P_{db} = Steady state power dissipation capacity of dynamic brake resistors obtained from Table 1a, 2a, or 3a (watts)

$$PL = \left[\frac{\quad}{\quad} \right] \times 100$$

$$PL = \quad \%$$

The calculation of PL in percent gives the percentage of the instantaneous power dissipated by the Dynamic Brake Resistors relative to the steady state power dissipation capacity of the resistors. This will give a data point to be drawn on the curve of **Figure 3**. The number calculated for PL will commonly fall between 300% and 600%. A calculated number for PL of less than 100% indicates that the Dynamic Brake Resistor has a higher steady state power dissipation capacity than is necessary.

Step 8 — Plot the Steady State and Transient Power Curves on Figure 3

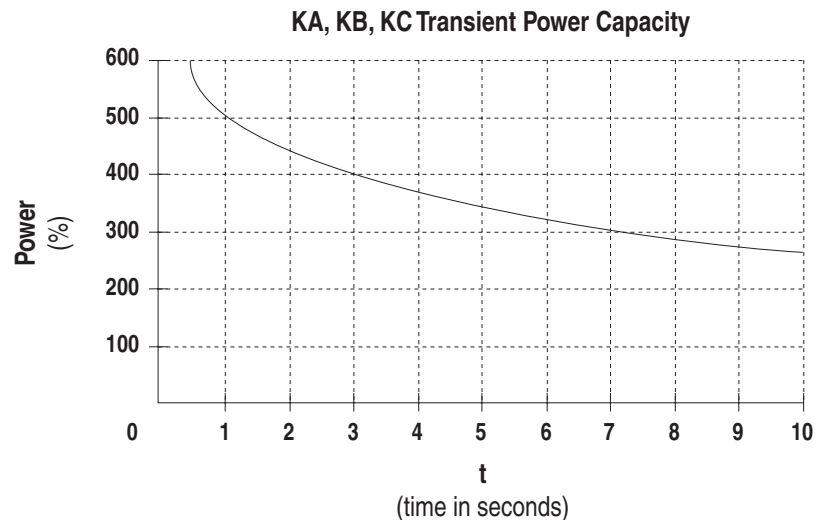
Draw a horizontal line equal to the value of AL (Average Load) in percent as calculated in **Step 6**. This value must be less than 100%.

Pick a point on the vertical axis equal to the value of PL (Peak Load) in percent as calculated in **Step 7**. This value should be greater the 100%.

Draw a vertical line at (t₃ - t₂) seconds such that the line intersects the AL line at right angles. Label the intersection point "Point 1".

Draw a straight line from PL on the vertical axis to Point 1 on the AL line. This line is the power curve described by the motor as it decelerates to minimum speed.

Figure 3
Plot Your Power Curve



If the line you drew lies to the left of the constant temperature power curve of the Dynamic Brake Resistor, then there will be no application problem.

If any portion of the line lies to the right of the constant temperature power curve of the Dynamic Brake Resistor, then there is an application problem. The application problem is that the Dynamic Brake Resistor is exceeding its rated temperature during the interval that the transient power curve is to the right of the resistor power curve capacity. It would be prudent to parallel another Dynamic Brake Module or apply a Brake Chopper Module with a separate Dynamic Brake Resistor.



ATTENTION: The heavy duty dynamic brake unit contains a thermostat to guard against overheating and component damage.

If the thermostat sensed excessive ambient temperature associated with a high duty cycle, torque setting, or overload condition, the thermostat will open and disable the brake until components cool to rated temperature. During the cooling period, no brake operation is available.

If reduced braking torque represents a potential hazard to personnel, auxiliary stopping methods must be considered in the machine and/or control circuit design.

Example Calculation

A 50 HP, 4 Pole, 460 Volt motor and drive is accelerating and decelerating as depicted in **Figure 2**.

- Cycle period (t_4) is 60 seconds
- Rated speed is 1785 RPM and is to be decelerated to 0 speed in 6.0 seconds
- Motor load can be considered purely as an inertia, and all power expended or absorbed by the motor is absorbed by the motor and load inertia
- Load inertia is directly coupled to the motor
- Motor inertia plus load inertia is given as 9.61 kg-m²

Calculate the necessary values to choose an acceptable Dynamic Brake Module.

$$\text{Rated Power} = 50 \text{ HP} \times 746 = 37.3 \text{ kW}$$

This information was given and must be known before the calculation process begins. This can be given in HP, but must be converted to watts before it can be used in the equations.

$$\text{Rated Speed} = 1785 \text{ RPM} = 2\pi \times 1785/60 = 186.93 \text{ Rad/s} = \omega_b$$

This information was given and must be known before the calculation process begins. This can be given in RPM, but must be converted to radians per second before it can be used in the equations.

$$\omega_o = 0 \text{ RPM} = 0 \text{ Rad/s}$$

$$\text{Total Inertia} = 9.61 \text{ kg-m}^2 = J_T$$

This value can be in lb-ft² or Wk², but must be converted into kg-m² before it can be used in the equations.

$$\text{Deceleration Time} = (t_3 - t_2) = 6.0 \text{ seconds.}$$

$$\text{Period of Cycle} = t_4 = 60 \text{ seconds.}$$

$$V_d = 750 \text{ Volts}$$

This was known because the drive is rated at 460 Volts rms. If the drive were rated 230 Volts rms, then $V_d = 375$ Volts, and if the drive were rated at 575 Volts rms, then $V_d = 937.5$ Volts.

All of the preceding data and calculations were made from knowledge of the application under consideration. The total inertia was given and did not need further calculations as outlined in **Step 1**.

$$\text{Peak Braking Power} = P_b = \frac{J_T \times \omega_b(\omega_b - \omega_o)}{(t_3 - t_2)} = 55.95 \text{ kW}$$

This is 150% rated power and is equal to the maximum drive limit of 150% current limit. This calculation is the result of **Step 2** and determines the peak power that must be dissipated by the Dynamic Brake Resistor.

$$R_{db1} = 0.9V_d^2/P_b = 9.05 \text{ ohms}$$

This calculation is the result of **Step 3** and determines the maximum ohmic value of the Dynamic Brake Resistor. Note that a choice of $V_d = 750$ Volts DC was made based on the premise that the drive is rated at 460 Volts.

The most cost-effective combination of Dynamic Brake Modules chosen in **Step 4** is one 1336-MOD-KB050 and one 1336-MOD-KB010 operated in parallel. This results in an equivalent Dynamic Brake Resistance of 8.76 ohms.

By comparison, a KB050 paralleled with a KB005 results in an equivalent Dynamic Brake Resistance of 9.57 ohms, which is greater than the maximum allowable value of 9.05 ohms. If two KB050 Dynamic Brake Modules are paralleled, the equivalent resistance would be 5.25 ohms, which will satisfy the resistance criteria set by **Step 3**, but is not cost effective.

$$P_{av} = \frac{(t_3 - t_2)}{t_4} \times \frac{P_b}{2} \left(\frac{\omega_b + \omega_o}{\omega_b} \right) = 2.8 \text{ kW}$$

This is the result of calculating the average power dissipation as outlined in **Step 5**. Verify that the sum of the power ratings of the Dynamic Brake Resistors chosen in **Step 4** is greater than the value calculated in **Step 5**.

$$AL = 100 \times P_{av}/P_{db} = 32\%$$

This is the result of the calculation outlined in **Step 6** and is less than 100%.

Draw AL as a dotted line on Figure 4.

$$PL = 100 \times P_b/P_{db} = 617\%$$

This is the result of the calculation outlined in **Step 7** and should always be greater than 100%.

Figure 4
Power Curve Out of Range

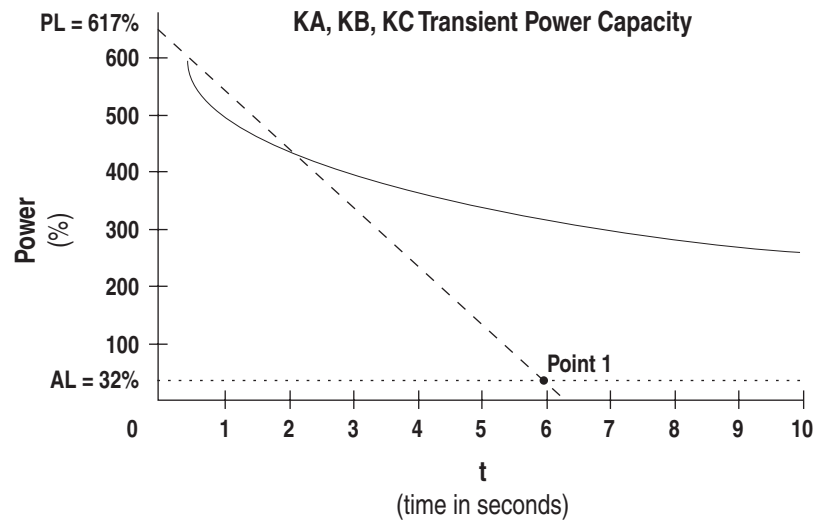


Figure 4 is the result of **Step 8**. Note that a portion of the motor power curve lies to the right of the constant temperature power curve of the Dynamic Brake Resistor. This means that the resistor element temperature is exceeding the operating temperature limit. This could mean a shorter Dynamic Brake Resistor life than expected. To alleviate this possibility, use two KB050 Dynamic Brake Modules in parallel and recalculate.

AL = 20%

PL = 400%

Figure 5
Power Curve In Range

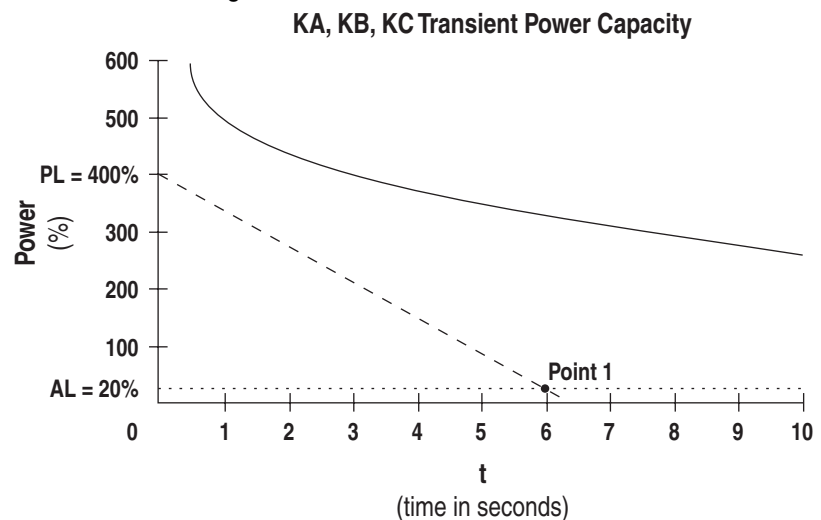


Figure 5 is the result of **Step 8** using two KB050 Dynamic Brake Modules in parallel and the graph indicates that the resistive element temperature will not exceed the operational limit.

Table 1a**Maximum Ratings for 230V AC Drives, 375 Volts Turn-on Voltage**

Dynamic Brake Module Catalog No. 1336-MOD-	Resistance Value of Dynamic Brake Resistor (Ohms)	Average Wattage Dissipation of Dynamic Brake Resistor (Watts)
KA 005	28.0	666
KA 010	13.2	1650

Table 2a**Maximum Ratings for 380-460V AC Drives, 750 Volts Turn-on Voltage**

Dynamic Brake Module Catalog No. 1336-MOD-	Resistance Value of Dynamic Brake Resistor (Ohms)	Average Wattage Dissipation of Dynamic Brake Resistor (Watts)
KB 005	108.0	1500
KB 010	52.7	2063
KB 050	10.5	7000

Table 3a**Maximum Ratings for 575V AC Drives, 937.5 Volts Turn-on Voltage**

Dynamic Brake Module Catalog No. 1336-MOD-	Resistance Value of Dynamic Brake Resistor (Ohms)	Average Wattage Dissipation of Dynamic Brake Resistor (Watts)
KC 005	108.0	1500
KC 010	52.7	2063
KC 050	15.8	8000

Specifications

Braking Torque	100% torque for 20 seconds (typical).
Duty Cycle	20% (typical).
Input Power	DC power supplied from DC Bus. Customer supplied 115V AC, 1Ø, 50/60 Hz required for KB050 & KC050 brake operation. Enable Signal: 50 mA Fan Power: 600 mA
Optional Brake Fault Contact	(1) N.O. contact, TTL compatible, closed when 115V AC is applied, open when a brake fault or loss of power occurs. Customer supplied 115V AC, 50 mA required for KA005, KB005, KC005, KA010, KB010 & KC010 optional brake fault contact monitoring. UL/CSA Rating: 0.6 Amps, 125VAC. 0.6 Amps, 110VAC. 2.0 Amps, 30VAC. Initial Contact Resistance: 50mΩ maximum.
Temperature	-10°C to 50°C (14°F to 122°F).
Humidity	5% to 95% non-condensing.
Atmosphere	NEMA Type 1 — Cannot be used in atmospheres having corrosive or hazardous dust, vapor or gas.
Altitude Derating	1,000 meters (3,300 feet) maximum without derating.
Enclosure Type	KA005, KB005, KC005 — IP20 (NEMA Type 1) KA010, KB010, KC010 — IP20 (NEMA Type 1) KB050, KC050 — IP00 (Open)

Installation Requirements



ATTENTION: Electric Shock can cause injury or death.
Remove all power before working on this product.

For all Dynamic Brake ratings, DC brake power is supplied from the drive DC Bus. In addition:

1. Dynamic Brakes KB050 and KC050 have fans and an enable circuit that requires a 115V AC user power supply.
2. Optional brake fault contact monitoring also requires a 115V AC user power supply. For KB050 and KC050 brakes, the same AC power supply may be used.

Hazards of electrical shock exist if accidental contact is made with parts carrying bus voltage. A bus charged indicator on the brake enclosures provides visual indication that bus voltage is present. Before proceeding with any installation or troubleshooting activity, allow at least one minute after input power has been removed for the bus circuit to discharge. Bus voltage should be verified by using a voltmeter to measure the voltage between the +DC and -DC terminals on the drive power terminal block. Do not attempt any servicing until bus charged indicating lights have extinguished and bus voltage has diminished to zero volts.

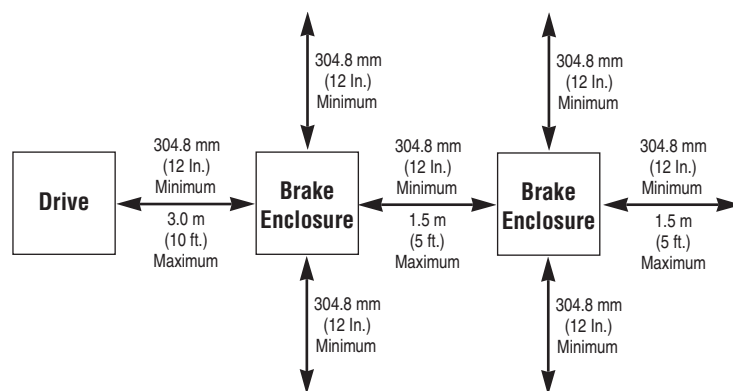
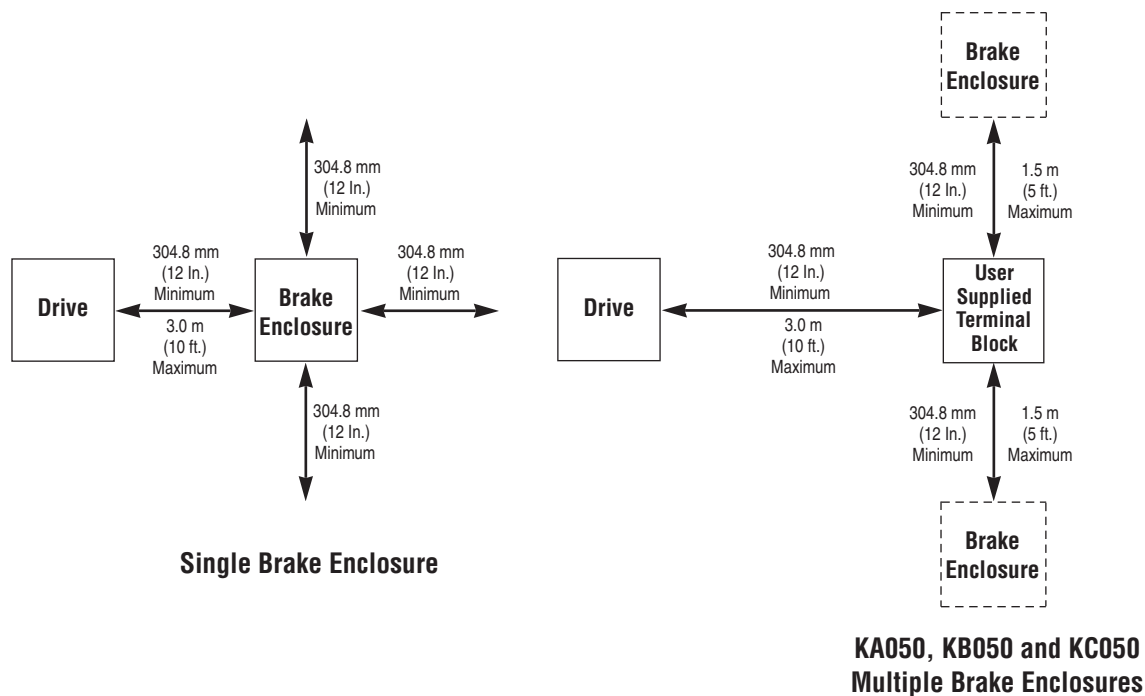
Mounting Requirements

Dynamic brake enclosures must only be installed in the vertical position. Select a location using the guidelines below and information provided in the Recommended Brake Configurations section.

- Each dynamic brake enclosure must be mounted outside of any other enclosure or cabinet and exposed to unrestricted circulating air for proper heat dissipation. Allow a minimum of 304.8 mm (12 in.) between brake enclosures and all other enclosure or cabinets including the drive.
- Each enclosure must be mounted in an area where the environment does not exceed the values listed in the specification section of this publication.
- If only one dynamic brake enclosure is required, the enclosure must be mounted within 3.0 m (10 ft.) of the drive.
- If more than one KB050 or KC050 brake enclosure is required, a separate user supplied terminal block must be mounted within 3.0 m (10 ft.) of the drive. Allow a maximum distance of 1.5 m (5 ft.) between each brake enclosure and the terminal block.
- If more than one KA005-KA010, KB005-KB010 or KC005-KC010 brake enclosure is required, the first enclosure must be mounted within 3.0 m (10 ft.) of the drive. Allow a maximum distance of 1.5 m (5 ft.) between each remaining brake enclosure.
- Separate conduit must be provided for the control connections between multiple brake enclosures.
- Separate conduit must be provided for the DC power connections between brake enclosures, the terminal block (if required) and the drive. For AC power connection and conduit requirements, refer to your 1336, 1336VT, 1336 PLUS II, or 1336 FORCE User Manual.

IMPORTANT: The National Electrical Codes (NEC) and local regulations govern the installation and wiring of the Heavy Duty Dynamic Brake. DC power wiring, AC power wiring, control wiring and conduit must be sized and installed in accordance with these codes and the information supplied on the following pages.

Recommended Brake Configurations



**KA005-KA010, KB005-KB010 and KC005-KC010
Multiple Brake Enclosures**

Brake Fault Contact Monitoring

For all brake ratings a fault contact has been provided to provide a remote output signal to an Allen-Bradley 1336-MOD-L3, L6 or PLC. Should a brake fuse fail, the brake thermostat trip (or for KB050 & KC050 units the brake enable signal be lost), the brake fault contact will open.

Interconnection wiring for remote brake monitoring is provided in the **Wiring Schemes**.

Brake Fuses

All dynamic brakes are internally fused to protect brake components. When replacing brake fuses, use only the type and size specified below.

Dynamic Brake	Fuse	Type	Rating
KA005	F1	A50P10 or Equivalent	10A, 500V
KB005	F1	A60Q or Equivalent	5A, 600V
KC005	F1	FWP-5 or Equivalent	5A, 700V
KA010	F1	A50P20 or Equivalent	20A, 500V
KB010	F1	A60Q or Equivalent	10A, 600V
KC010	F1	FWP-10 or Equivalent	10A, 700V
KB050	F1 & F2	A70QS35 or Equivalent	35A, 700V
KC050	F1 & F2	A70QS35 or Equivalent	35A, 700V

Brake Module Jumper Settings

For the **Recommended Brake Configurations** shown on the previous page as well as the interconnection diagrams shown on the following pages, there can be only one master brake to control dynamic braking. When multiple brakes are used, only one brake can serve as the master brake to control the remaining slave brakes.

KA005-KA010
KB005-KB010
KC005-KC010



KB050
KC050



Master Brake Module Jumper Settings

For the master brake, leave slave/master jumper W1 factory set to master — Between jumper positions 2 & 3.

KA005-KA010
KB005-KB010
KC005-KC010



KB050
KC050



Slave Brake Module Jumper Settings

In each slave enclosure, reset jumper W1 to slave — Between jumper positions 1 & 2

KB005-KB010



KB050

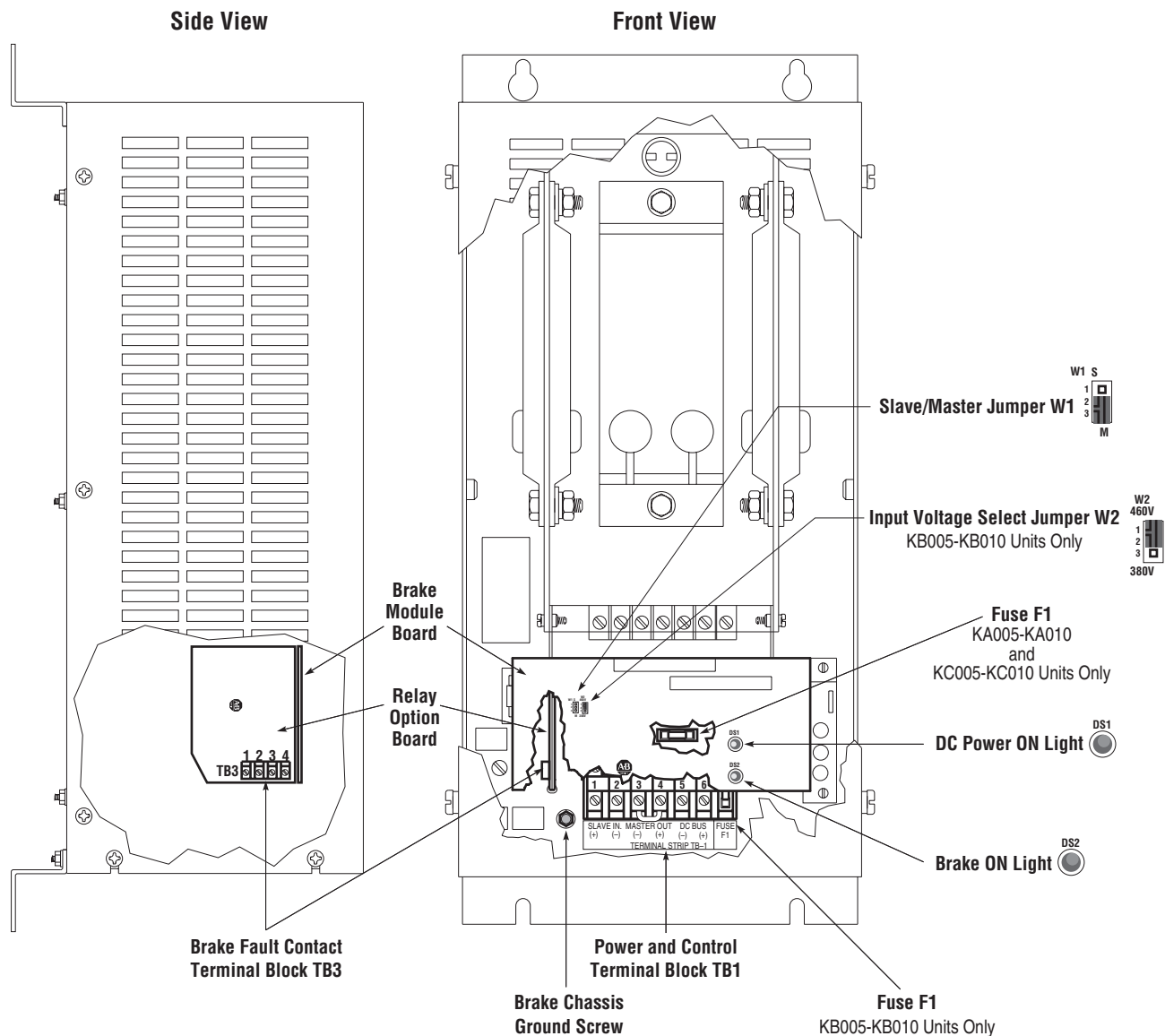


Input Voltage Jumper Settings

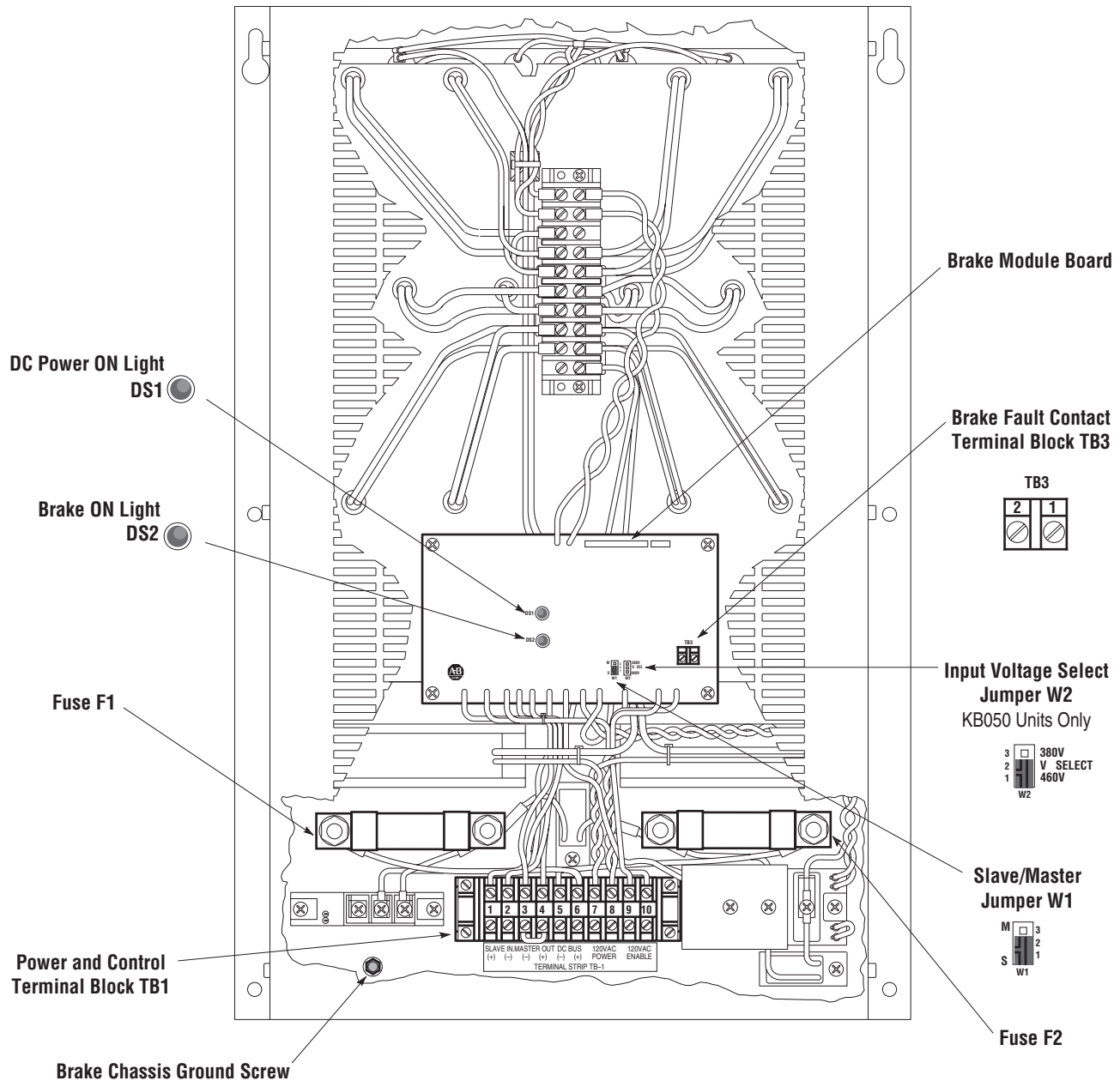
For KB brakes, remember to set jumper W2 in all enclosures to correspond to the nominal drive input voltage. Setting the jumper between positions 1 & 2 will select an input voltage of 415/460 volts. Setting the jumper between positions 2 & 3 will select an input voltage of 380 volts.

KA and KC brakes do not have input voltage jumpers.

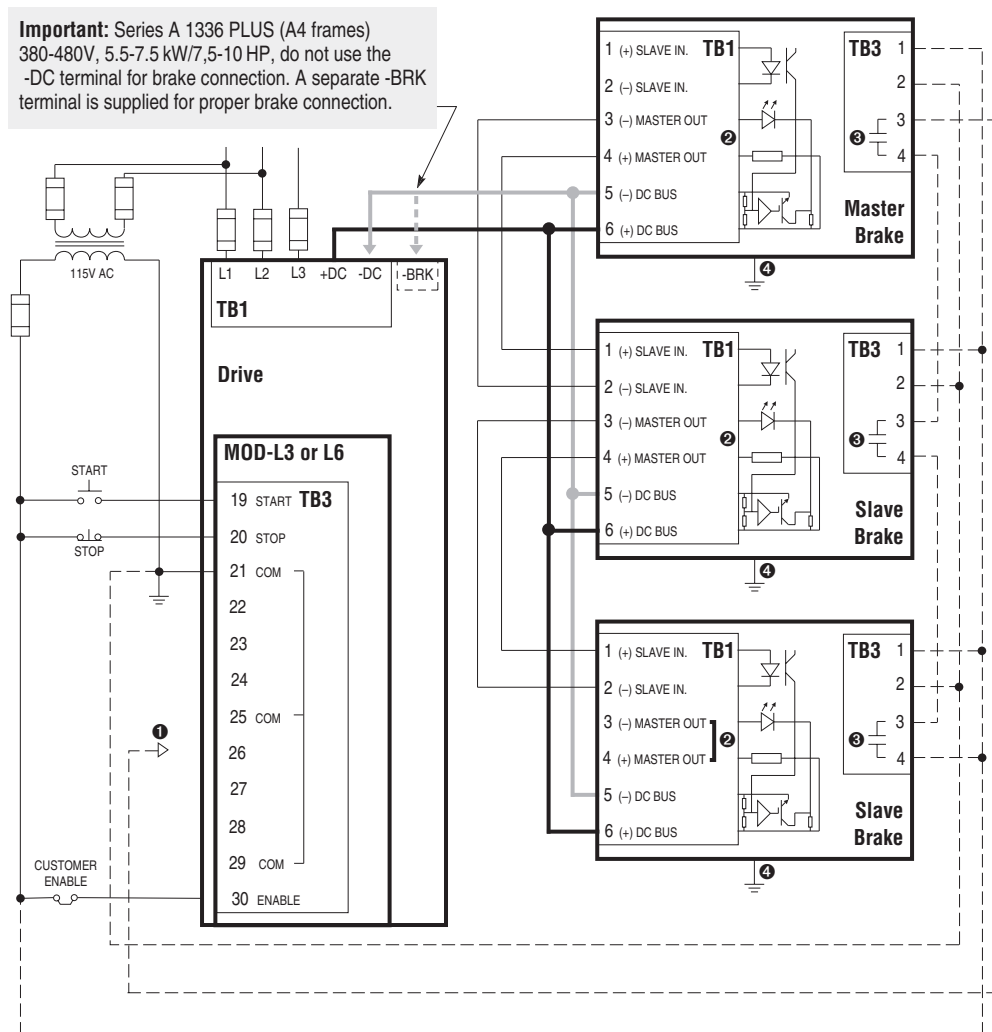
KA005-KA010, KB005-KB010 and KC005-KC010 Terminal Block, Fuse and Jumper Locations



KB050 and KC050 Terminal Block, Fuse and Jumper Locations



KA005-KA010, KB005-KB010 and KC005-KC010 Wiring Scheme



— Brake Power Wiring
— Brake Power Wiring

All DC Brake Power Wiring must be twisted pair and run in conduit separate from Control Wiring.
Minimum required DC Brake Power Wiring sizes are listed in **tables 1b, 2b and 3b**.

— Control Wiring

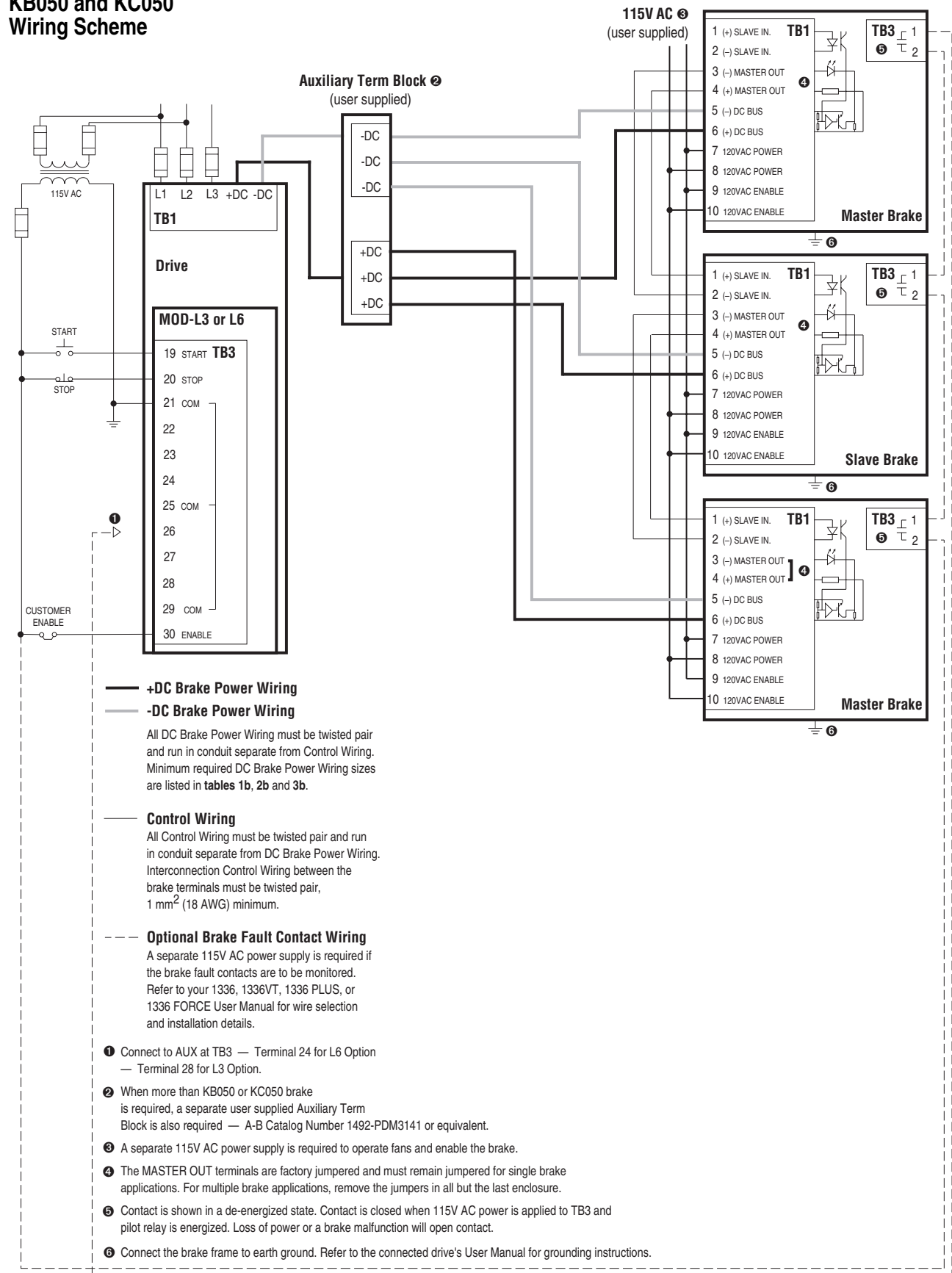
All Control Wiring must be twisted pair and run in conduit separate from DC Brake Power Wiring.
Interconnection Control Wiring between the brake terminals must be twisted pair, 1 mm² (18 AWG) minimum.

--- Optional Brake Fault Contact Wiring

A separate 115V AC power supply is required if the brake fault contacts are to be monitored.
Refer to your 1336, 1336VT, 1336 PLUS, or 1336 FORCE User Manual for wire selection and installation details.

- ① Connect to AUX at TB3 — Terminal 24 for L6 Option — Terminal 28 for L3 Option.
- ② The MASTER OUT terminals are factory jumpered and must remain jumpered for single brake applications.
For multiple brake applications, remove the jumpers in all but the last enclosure.
- ③ Contact is shown in a de-energized state. Contact is closed when 115V AC power is applied to TB3 and pilot relay is energized.
Loss of power or a brake malfunction will open contact.
- ④ Connect the brake frame to earth ground. Refer to the connected drive's User Manual for grounding instructions.

KB050 and KC050 Wiring Scheme



DC Power Wiring TablesRequired Minimum DC Power Wiring Sizes in mm² and (AWG)**Table 1b — DC Brake Power Wiring for 200-240V AC Drives**

for drive rating	with	Drive – Auxiliary Term Block wire size	Drive – Master or Auxiliary Term Block - Master wire size	Master – Slave wire size	Slave – Slave wire size
AQF05-AQF50	(1) KA005	—	6 (10)	—	—
A007-A010	(1) KA010	—	6 (10)	—	—
A015	(1) KA005 + (1) KA010	—	6 (10)	6 (10)	—
A020	(2) KA010	—	6 (10)	6 (10)	—

Table 2b — DC Brake Power Wiring for 380-480V AC Drives

for drive rating	with	Drive – Auxiliary Term Block wire size	Drive – Master or Auxiliary Term Block - Master wire size	Master – Slave wire size	Slave – Slave wire size
BRF05-BRF50 B003-B005	(1) KB005	—	4 (12)	—	—
B007-B010	(1) KB010	—	4 (12)	—	—
B015	(1) KB005 + (1) KB010	—	4 (12)	4 (12)	—
B020	(2) KB010	—	4 (12)	4 (12)	—
BX040 BX060 B040-B060	(1) KB050	—	6 (10)	—	—
B075-B100	(2) KB050	16 (6)	6 (10)	—	—

Table 3b — DC Brake Power Wiring for 500-600V AC Drives

for drive rating	with	Drive – Auxiliary Term Block wire size	Drive – Master or Auxiliary Term Block - Master wire size	Master – Slave wire size	Slave – Slave wire size
C003-C005	(1) KC005	—	4 (12)	—	—
C007-C010	(1) KC010	—	4 (12)	—	—
C015	(1) KC005 + (1) KC010	—	4 (12)	4 (12)	—
C020	(2) KC010	—	4 (12)	4 (12)	—
C040-C060	(1) KC050	—	6 (10)	—	—
C075-C100	(2) KC050	16 (6)	6 (10)	—	—

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